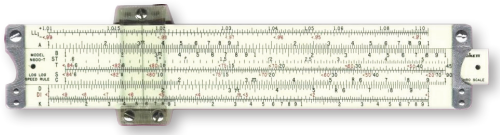
A high-school-aged Jane Hamilton and her dog. In 1932, Jane graduated from South High School in her hometown of Denver, Colorado.
(Photo courtesy Linda Hall)



JANE HALL: QUEEN OF THE HILL

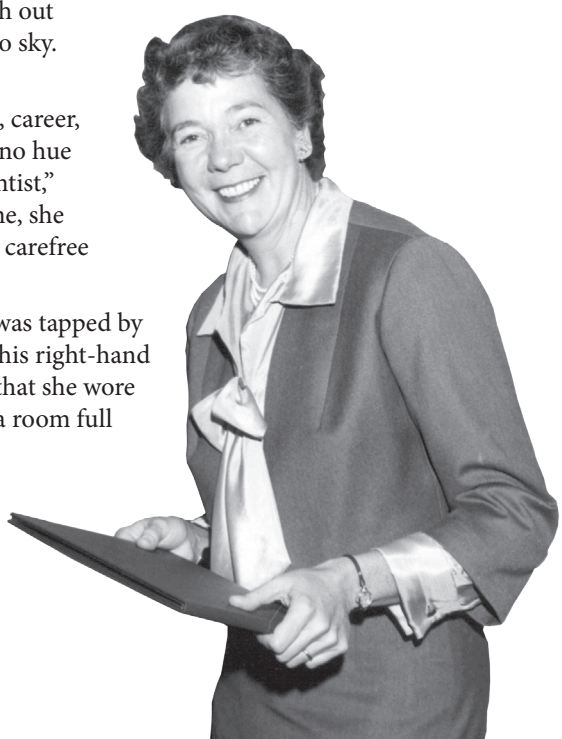
The Laboratory's first female assistant director brought smarts, style, and a steady hand to Los Alamos.

June 30, 1970
Los Alamos, New Mexico

Driving east along New Mexico Highway 4, Dr. Jane Hamilton Hall descended between towering tuff mesas and crossed the murky Rio Grande. As she cruised through San Ildefonso Pueblo, she glanced in her rearview mirror and saw the sun setting—spectacularly, as it always does in New Mexico—above the rugged peaks of the Jemez Mountains.

She tried to savor the streaks of red, orange, and yellow, knowing this was the last time she'd make this drive from Los Alamos Scientific Laboratory to her home on Circle Drive in Santa Fe. The 35-minute commute, filled with so many colors and expansive landscapes, had become a much-anticipated part of her day. But no more. As of 5 p.m., Jane had officially retired from her position of assistant director.

Jane thought back over her 25 years at the Laboratory. She had practically been a kid when she arrived there—only 30 years old, three years out of grad school, and recently married to fellow physicist David B. Hall. She'd felt life's possibilities stretch out before her, bigger and brighter than the vast New Mexico sky.



Her enthusiasm was apparent, and she flourished in the Laboratory's physics and weapons divisions. "Education, career, and the latter-day duties of a wife and mother have cast no hue of sobriety on the personality of this young woman scientist," reported the *Los Alamos Times* in April 1947. "Thirty-one, she retains a youthful vivacity that shows itself in a frequent carefree smile and the impression she gives of abundant energy."

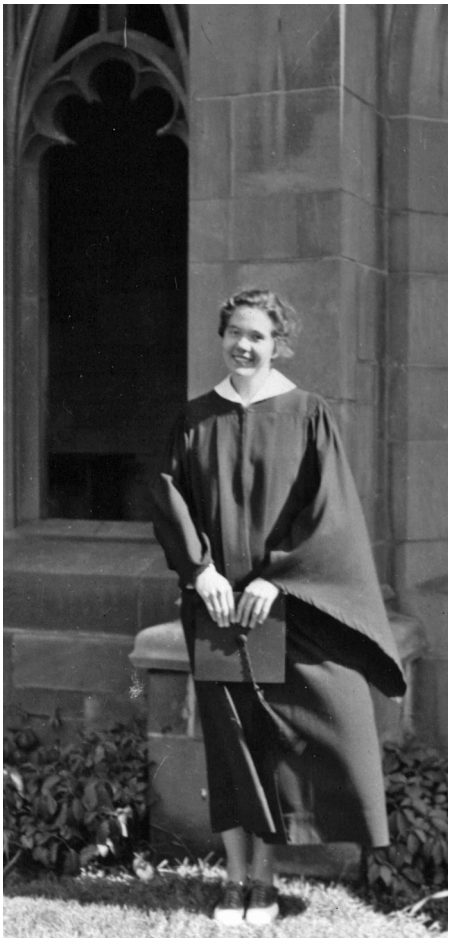
After 10 years of rising quickly through the ranks, Jane was tapped by the Laboratory director himself, Norris Bradbury, to be his right-hand woman. Assistant director was her formal title and one that she wore with pride, especially when she was the only woman in a room full of men—a frequent occurrence.

Jane and David's handsome combined income had allowed them to build their dream home high on

a hilltop on one of Santa Fe's most historic roads. They'd moved in four years ago and built the place with retirement in mind: a formal dining area ensured lively evenings with friends; nearby walking trails provided ample opportunity for exploring the area; and her favorite restaurant, El Nido, was only a five-mile drive down Bishop's Lodge Road.

Jane knew she would miss the daily hustle and bustle of the Laboratory and the wonderful people she'd gotten to know there. But as she parked her car in the garage and entered her house, she realized it was time to let management go and focus on the next chapter. Science would always be a part of her life, she thought, glancing down to the kitchen counter at a paper where she'd calculated when she could remove a roast from the oven, let it rest, and serve it at a perfect medium rare.

She smiled and set her bag down. Retirement was going to be just fine.



Jane studied physics at the University of Chicago, where she earned a bachelor's degree in 1937, a master's degree in 1938, and a doctorate in 1942. (Photo courtesy of Linda Hall)

Catching the science bug

Born on June 23, 1915, Jane Elizabeth Hamilton grew up in Denver, Colorado, where her father was a pharmacist. While attending South High School from 1929 to 1932, "she got a spark that she never talked about," remembers her daughter, Linda Hall, an architect in Santa Fe. "Maybe it was in high school, learning science, where she said 'this is something that I can do."

After graduation, Jane decided to study physics at the University of Denver before transferring to the University of Chicago in 1935. There, she began ticking off degrees: a bachelor's in 1937, a master's in 1938, and a doctorate in 1942. Along the way, perhaps in the halls of the physics building, she saw a handsome young man "walking up or down some staircase," Linda recalls. "He had on a beautiful vest—a knitted red jumper—and she thought, 'he's for me!'"

That young man was David B. Hall, a New Jersey native and the son of a chemist married to a mathematician. After earning his bachelor's degree at Rutgers University, he'd enrolled at Chicago to pursue his master's and Ph.D. in physics.

The couple married in December 1939 and completed their doctoral theses while still enrolled at Chicago but working as graduate assistants in the physics department at the University of Denver. "They were unique," Linda says, "a husband and wife team earning their doctorates simultaneously." David's thesis work was in cosmic rays; Jane's was in crystallography. Her thesis, published in 1942, was titled "The Temperature Diffuse Scattering of X-Rays by Potassium Chloride and Potassium Bromide Crystals." That year, David was one of 3,036 men to receive a Ph.D. in the United States. Jane was one of 461 women in the country—and the only woman to earn a doctorate in physics at the University of Chicago.

In 1940, Jane and David (second and third from left, respectively) climbed Colorado's 14,271-foot Mount Evans alongside fellow scientists Winston Bostick, Norman Hilberry, Bruno Rossi, and Victor Regener. As Rossi wrote in his book, Moments in the Life of a Scientist, *the group of doctoral students was conducting experiments that would achieve "the first unambiguous demonstration of the anomalous absorption of mesotrons in the atmosphere, therefore proving their radioactive decay in flight." (Photo courtesy of Linda Hall)*

This photograph ran in the Chicago Sun *newspaper with the caption "First couple to come up as candidates for Ph.D. degrees at the same time at the University of Chicago is David B. Hall (center) and Mrs. Jane Hamilton Hall, shown with Samuel K. Allison, physics instructor."*

Jane and David were co-group leaders on Clementine, the world's first fast plutonium reactor. "The utmost responsibility is required of the Hall husband and wife," wrote physics division leader J.M.B. Kellogg in 1947. "Dr. Jane Hall is not of secondary importance in the exercise of this responsibility." (Photos: Los Alamos)

> **In 1942, Jane was one of 461 women in the country to earn a Ph.D.—and the only woman to earn one in physics at the University of Chicago.**

Doctorates in hand, both Halls ventured back to the University of Chicago in January 1943 to research graphite purity in the school's Metallurgical Laboratory. But by then the Second World War was raging, and the Halls felt compelled to contribute to the war effort. Hardly a year after establishing themselves in the Windy City, the couple moved 2,000 miles northwest to become part of the top-secret Manhattan Project in Washington state.

"We were asked to go out to Hanford to babysit the construction [of the B, D, and F nuclear reactors being built]," remembers David in a 1986 interview with the Atomic Heritage Foundation. "I and my wife, as Ph.D.s, were hired to do really quite menial tasks that could have been done by people without any training."

Officially employed by E.I. DuPont de Nemours and Company, Jane's position was senior supervisor of research in health physics, which required her to use particle-counting devices to monitor workers' radiation levels. She made $345 a month—more than twice the average U.S. income for that time.

> **"Los Alamos was considered to be the fountainhead of the pure science and the good ideas [about nuclear physics]."** ~David Hall

The Halls lived in a two-story house on Goethals Drive in Richland—one of many homes constructed hastily on government-sequestered farmland in anticipation of the 51,000-plus Manhattan Project workers arriving at Hanford. "Our front lawn…had asparagus coming up," David says.

Another "remarkable thing was that the contractor was not able to get bathtubs for the place, and so the bathtubs were poured concrete, which were kind of gritty on your bottom."

By the time the Halls helped get the reactors up and running in the spring of 1945, it was apparent that "there was no real science [at Hanford]," according to David. And so the couple went back to Chicago, where Jane served as assistant to the acting director of the Metallurgical Project (the Chicago branch of the Manhattan Project) at what's now Argonne National Laboratory. On July 16 of that year, scientists from Project Y (the Los Alamos branch of the Manhattan Project) detonated Trinity—the world's first atomic bomb—using plutonium produced at Hanford.

"Los Alamos was considered to be the fountainhead of the pure science and the good ideas [about nuclear physics]," David says.

According to Laboratory historian Alan Carr, "When you meet people who knew Jane Hall, two things happen: first, they're going to smile, and then they're going to tell you stories of how much they respected and admired her." Here, she attends a social event in May 1967. (Photo courtesy of Linda Hall)

And so perhaps it's no surprise that Los Alamos is where the Halls ended up in November 1945.

Becoming essential at Los Alamos

The Halls, now with newborn son, Malcolm, in tow, arrived in Los Alamos at a pivotal time for the Laboratory: the bombs had been dropped, and because the war had finally ended, many scientists were leaving the small New Mexico town. But the couple felt strongly that if the United States was going to base its national security policy on having nuclear weapons, then the United States should actually have nuclear weapons.

"We went [to Los Alamos] because we believed firmly that the work on nuclear weapons had to continue," Jane told the Associated Press in 1970. "Building nuclear weapons had to be done, there was no doubt about it."

> **"Although Mrs. Hall is one of the newer members of the group, her understanding of the work and her training makes her one of the most valuable members of the group." ~Alvin Graves**

Jane immediately went to work in the Laboratory's weapons research division, which was primarily concerned with the mechanics and dynamics of nuclear energy release. She earned $373 a month—a wage that her division leader didn't think was fair. "Mrs. Hall was offered a salary which was too low on the basis of her training and experience," wrote Alvin Graves in Jane's 1946 performance review. "Although Mrs. Hall is one of the newer members of the group, her understanding of the work and her training makes her one of the most valuable members of the group…This recommendation [of $430 a month—or roughly $2.69 per hour] is intended to bring her salary in line with those of comparable physicists on the project."

My Darling Clementine

Meanwhile, the world's first fast plutonium reactor was proposed and approved. The reactor would provide a means of exploring the adaptability of plutonium as a reactor fuel and gathering basic physics data for the nuclear weapons program. Construction began in August 1946 in Los Alamos Canyon, a deep ravine in the Pajarito Plateau just south of the Laboratory.

Under the direction of physicist Phillip Morrison, the new reactor was named Clementine after the song "My Darling Clementine," which is about the legendary forty-niners and begins "in a cavern, in a canyon…" Morrison likened his reactor personnel to modern-day forty-niners because 49 was the wartime code name for plutonium.

When Morrison accepted an offer to join the physics faculty at Cornell University, Jane and David Hall were asked to take his place as co-group leaders on the project. The duo's duties included planning the type and schedule of construction, testing at various stages of completion, experimental planning, responsibility for safety, writing reports, and interpretation of data.

Steve Lawroski (center), director of the chemical engineering division at Argonne National Laboratory, and Harvard professor Norman Ramsey (who would go on to win the Nobel Prize in Physics in 1989) were among the men who served alongside Jane on the General Advisory Committee of the Atomic Energy Commission. *(Photo courtesy of Linda Hall)*

Jane was often the only woman in a room full of men. Here, she sits with Nobel Prize-winning chemist and AEC Chairman Glenn Seaborg (far left) during his visit to Los Alamos in April 1961. (Photo: Los Alamos Historical Society)

"This is a position of extraordinarily grave responsibility since on [Jane's] judgment and skill and care…will devolve *[sic]* not only the success or failure of [an] extremely important and expensive enterprise, but also the safety and lives of quite a large number of people," wrote physics division leader J.M.B. Kellogg in November 1946. "She has been extremely diligent and enterprising in her work and has made marked contributions to the program."

> **"Jane Hall's contributions to the development have been considerable, and her work has been excellent."**
> **~J.M.B. Kellogg**

After core criticality was achieved in 1946, completion of the reactor took 27 more months, and Kellogg's praise of Jane continued in subsequent performance reviews. In 1947, he wrote, "Since no such pile has been built before, and since it is known that this reactor is more dangerous than other piles, the utmost responsibility is required of the Hall husband and wife. Dr. Jane Hall is not of secondary importance in the exercise of this responsibility." And in 1948, he said, "It is well known that this responsibility is no light one. Jane Hall's contributions to the development have been considerable, and her work has been excellent."

Clementine operated through 1952, and most of its original objectives were realized: important nuclear weapon data had been acquired and invaluable experience had been gained in the design and control of fast reactors. Clementine was "another step toward finding the best type of chain reactor for the production of useful power," according to a September 8, 1947 article in *Newsweek* magazine.

Making the most of management

By 1950, shortly after the birth of her daughter, Linda, Jane was promoted to assistant technical associate director of the Laboratory, a position she held until her appointment as assistant director in 1955.

"Technically, Jane was the Lab's only female assistant director," says Laboratory historian Alan Carr, noting that Jane was likely the only person—male or female—to ever hold that exact position. "The assistant director back in those days was the rough equivalent of deputy director today." (Only two women—Carolyn Mangeng and Beth Sellers—have held that title.)

Despite the 1950s being a time of intense discrimination against women, when Bradbury named Hall his assistant director, "there was no reaction" remembers physicist John Hopkins, then a summer student who would later become the associate director for the nuclear weapons program. "She was no-nonsense but easy to talk to; she was just one of the boys."

In September 1958, Jane (bottom right) attended the second United Nations International Conference on the Peaceful Uses of Atomic Energy in Geneva, Switzerland. At this time, Jane was not only the assistant director at Los Alamos but also the technical secretary of the General Advisory Committee of the Atomic Energy Commission. *(Photo courtesy of Linda Hall)*

"My mother was an outstanding manager," remembers Malcolm, who now resides in New York City. "At Los Alamos, she was a little rueful about leaving scientific work for administration, but she acknowledged this was where she could make her most significant contributions."

Well liked for her "cultured and slightly demure manner" (as described in a 1947 *Los Alamos Times* article), as assistant director, Jane was often tasked with hosting visiting scientists. "She was well known for throwing fabulous parties when luminaries such as [physicist and Nobel laureate] I.I. Rabi were in town," Malcolm says. "She was also a good sport for squiring VIPs around; once she escorted philanthropist and socialite Catherine Hearst, then a regent of the University of California [which operated the Lab], to watch an H-bomb test in the Pacific."

> **"She always did everything first class. It must have had something to do with how she wanted to be in the world that included the best." ~Linda Hall**

On one occasion First Lady Ladybird Johnson telephoned to personally invite Jane to an event at the White House. "Malcolm left a note on the kitchen blackboard that 'Ladybird called,'" Linda remembers. "And it caused consternation because Mom felt she had to have a hat to wear to the luncheon; she never wore hats, but she knew the importance of her appearance."

Thankfully, Jane still had ties to her hometown of Denver—but not so much to the few family members who still lived there. "It was the May Company and Denver Dry Goods that drew her to Denver—and a stay at the Brown Palace," says Linda, noting that her mother would travel to Denver twice a year to update her wardrobe with the most current fashions (including hats, if necessary). "She always did everything first

Linda Hall (left) and Carla Breiner of the Los Alamos Women's Group unveil a plaque at the recently dedicated Jane Hall Conference Center. *(Photo: Los Alamos)*

class," Linda continues. "It must have had something to do with how she wanted to be in the world that included the best."

Influencing the nuclear weapons debate

But Jane's tenure as associate director certainly wasn't all entertaining and high fashion. "She really was a remarkable scientist," Carr says. "And to have such a senior management position so early in her career and for so long was almost unheard of in those days for a woman."

Jane once told a reporter, "If a scientist has technical knowledge that is going to influence the debate [about nuclear weapons], then he must participate." Perhaps that's why President Lyndon Johnson appointed her to a six-year term on the General Advisory Committee (GAC) of the Atomic Energy Commission (AEC) in September 1966. The GAC was established by the Atomic Energy Act of 1946 to advise the AEC on scientific and technical matters relating to materials, production, research, and development of nuclear power.

"The GAC was the real group of experts," Carr explains. "If you were [one of the nine people] on the GAC, you were advising the people who were advising the president on very serious matters. The head of the AEC was the very rough equivalent of today's Secretary of Energy—it was a very big deal."

> **"If a scientist has technical knowledge that is going to influence the debate [about nuclear weapons], then he must participate." ~Jane Hall**

Jane, the first woman appointed to the GAC, had previously served as technical secretary of that committee from 1956 to 1959. She also served as a member of the GAC's committee on Nuclear Materials Safeguards. She later declined an invitation by President Richard Nixon to become chair of the AEC. "I think it would have meant moving to Washington," Linda speculates.

Regardless, upon her retirement in 1970, Jane received the AEC Citation award for "outstanding service to the nation's atomic energy program…and for her leadership and continuing contributions in physics research and laboratory management." She was the first woman to receive the award since the AEC's establishment in 1958.

> **"It's quite possible that we have plutonium produced by Clementine here at the TA-55 plutonium facility today." ~Jeff Yarbrough**

In January 1971, *Ladies Home Journal* named Jane one of the 75 most important women in the country for her work on the AEC. The article (sandwiched between the "keep-your-husband" diet and advice on how to wear pants) celebrated Jane alongside notable women including Joan Baez, Katherine Graham, Coretta Scott King, Jacqueline Kennedy Onassis, and others who "had made the greatest impact on our civilization within the last five years and who would continue to affect us significantly for the next five years."

The legacy continues at Los Alamos

Jane's legacy has far surpassed that five-year benchmark. On October 4, 2016, nearly 46 years after her retirement and 35 years after her death in 1981, Jane was remembered by the Laboratory when a meeting space was named in her honor. The Jane Hall Conference Center sits on the fourth floor of the Radiological Laboratory Utility Office Building at Technical Area-55, which is the center of plutonium research at Los Alamos. In fact, as associate director for Plutonium Science and Manufacturin Jeff Yarbrough pointed out, "It's quite possible that we have plutonium produced by Clementine here at the TA-55 plutonium facility today."

The new conference center includes a 42-by-8-foot mural featuring Jane's name and image. Walls are adorned with quotes by or about her, and a small display case features photographs and letters from her family's collection. A bronze plaque depicts Jane, the original Manhattan Project main gate, and an early representation of a plutonium atom.

"It was beautiful," says Linda of the dedication ceremony. "She never talked much about work—and as a kid, I never thought to ask—so I was pleased and proud to see her accomplishments recognized so publicly at the Laboratory that meant so much to her."

~Whitney J. Spivey